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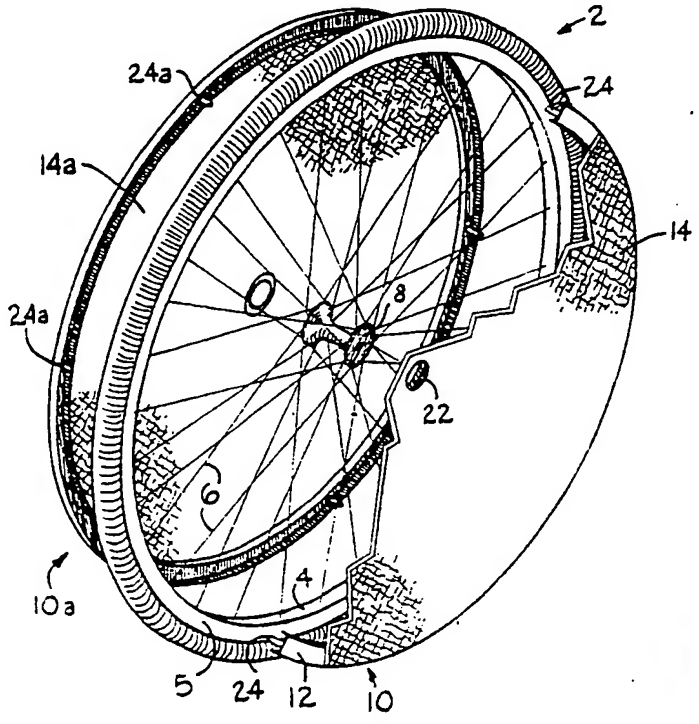
(54) Title: FABRIC COVER FOR SPOKED WHEELS

(57) Abstract

A light weight, porous wheel cover (10, 28) for reducing the aerodynamic drag and reducing the 'sail' effect of side winds on covered spoked wheels (2). The cover comprises a protruded graphite/fiber ring (12, 30) sized to fit snugly within the rim (4) of the wheel (2). A porous fabric cover facing (14, 40) spans the ring (12, 30) except for a central axle opening (22). In a first embodiment, the facing (14) is stretched and adhesively attached to a U-shaped ring (12) and the ring is removably attached by split pins (24) to the spokes (6). In a preferred second embodiment, the ring (30) has a peripheral bead (38) and the facing (40) is retained on the bead (38) by a flexible retainer strip (42) having a concave channel (44) fitting over the bead, the covers (28, 28a) being retained on the wheel by interconnection of the rings (30, 30a) of opposed covers by connecting members (48) having enlarged ends (50, 52) frictionally retained within inwardly facing concave channels in the rings. The respective rings, flexible strips (42, 42a) and connecters (48) all have a like cross-section throughout, so as to be readily formable as by protrusion. The covers are of use on spoked wheels in general and are especially advantageous for use on racing bicycles, sulkies, racing wheelchairs and the like.



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Description

LIGHT WEIGHT WHEEL COVERS FOR SPOKED WHEELS

Background of the Invention

Cross-reference to Related Applications

This application is a continuation-in-part of U.S. Design patent application Serial No. 06/ 763,646, entitled Wheel Covers for Spoked Vehicular Wheels, Such as Racing Bicycle Wheels, and filed 8 August, 1985.

Technical Field

This invention relates to spoked wheel covers, and more particularly to light weight, porous detachable wheel covers fabricated of stretchable material such as knit nylon fabric or the like, for use on the spoked wheels of racing bicycles and the like.

Description of the Prior Art

Wheel covers for the spoked wheels of bicycles and the like are the subject of quite a number of prior art patents. In Schaffer U.S. Patent No. 4,418,962, for example, there is disclosed bicycle spoked wheel covers which are formed of molded plastic and which are of solid, apparently rigid construction. The Schaffer covers are arranged in clamped engagement with the outer surfaces of the wheel rim, and are interconnected by bolt means or snaps. Being solid, rigid and impervious from rim edge to rim edge, such wheel covers are unduly heavy and extend out beyond the inner diameter of the rim and would thus interfere with the action of caliper brake pads. Being solid, they would have as much "sail" effect in a side wind as conventional solid face disc wheels. Another example of bicycle spoked wheel disc covers which comprise essentially solid faces extending substantially across the entire inner diameter

of a bicycle spoked wheel are shown in Seltman U.S. Patent No. 4,202,582, the covers in this instance including several quadrantly arranged openings to accomodate fastener means of the bendable prong type interconnecting the discs, the disc members themselves being disclosed as being fabricated from plastic, metal of other materials and of a reflective nature for safety purposes. The Seltman disc covers are diametrically split with overlapping hemicircular sections for ease of installation and removal. McLean U.S. Patent No. 863,083 is an old showing of a spoked wheel cover which not only extends from the axle to the rim of the wheel but also surrounds the wheel tire.

Many wheel covers shown in prior art patents are simply partial covers, extending from the axle or hub only part of the way to the wheel rim, as in Guingrich U.S. Patent No. 3,141,704, Kraft U.S. Patent No. 1,878,528, Wester U.S. Patent No. 3,317,246 and Kain U.S. Patent No. 3,924,898. Others involve radial segments or blades, such as in Dowhan U.S. Patent No. 3,579,408, Patane U.S. Patent No. 3,602,550, and Iwamoto U.S. Patent No. 4,296,939. Still others involve radial slits or a convoluted configuration, the cover being threaded between spokes, as in Eirinberg et al U.S. Patent No. 3,565,489 and Laurion U.S. Patent No. 3,847,443.

An article discussing Kevlar tension wheels for use as bicycle disc wheels appears in Bicycle Guide issue of December, 1984 at pages 81-83, which article is entitled "Fast Wheels At The Olympics" and is offered by Eric Edwards. A further article entitled "Olympic Bikes" by Edmund R. Burke appears in Cyclist, issue of January, 1985, at page 36. The December 1985 issue of Bicycling includes an article entitled "Aerodynamic Wheels", at pages 121-124.

When pedaling a bicycle, a cyclist must overcome three forces: aerodynamic drag, rolling resistance, and mechanical friction. While the latter two remain relatively constant as speed increases, aerodynamic drag increases singnificantly with speed. Riding at twenty miles per hour (32 km/hr), approximately 80% of a cyclist's effort is devoted to overcoming aerodynamic drag, a substantial amount of which is caused by the spokes of the bicycle's wheels.

A significant portion of the total aerodynamic drag of a spoked wheel bicycle and cyclist can be eliminated by reducing the aerodynamic drag created by the bicycle's wheels, either by covering the sides of a conventional spoked wheel, or by replacing the spoked wheels with disc wheels. A conventional disc wheel comprises a rigid circular disc extending between an axle and a rim of the wheel. There are presently two alternative designs for disc wheels. In solid core disc wheels, the disc comprises a lightweight honeycomb bonded between two thin rigid graphite facing sheets. In tension disc wheels, the disc comprises two thin rigid pre-tensioned facing sheets separated by a hollow central cavity. Test results show that a disc wheel creates only 50-60% of the aerodynamic drag of a conventional spoked wheel. Simply adding a full wheel cover to a conventional spoked wheel provides approximately 90% of the benefit in aerodynamic drag reduction provided by a disc wheel. Thus if aerodynamic drag is the only consideration, and disregarding the weight disadvantage inherent in a disc wheel, disc wheels are marginally superior to spoked wheels with solid wheel covers in terms of drag reduction.

However, disc wheels significantly increase the effective side area of a bicycle. This poses no serious problem when the disc wheels are used indoors, but can

produce dramatic and potentially dangerous consequences outdoors in side winds. Side winds blowing transversely across the bicycle produce what is known as a "sail" effect, i.e. an overturning force which must be physically resisted by the cyclist's muscles, such as by the cyclist turning the bicycle toward and inclining the bicycle slightly into the side wind. If the effective side area is increased by the use of disc wheels, the bicycle responds more rapidly and more violently to side winds, and the cyclist must expend more energy to maintain stability.

Side winds blowing against the front wheel tend to turn it in the downwind direction, forcing the bicycle off course and requiring the cyclist to twist the front wheel back on track. It has been proposed that the steering problem associated with disc wheels can be reduced by combining a spoked front wheel with a disc rear wheel. However, with such an arrangement the front wheel of a bicycle produces much more aerodynamic drag than the rear wheel, since the rear wheel moves through the turbulent air behind the front wheel, the bicycle frame and the cyclist's body. Thus, stability and steering problems severely limit the use of disc wheels as front wheels, where they could otherwise provide the greatest benefit in reducing aerodynamic resistance.

High construction costs have pretty well limited present-day disc wheels to elite, well-funded racing cyclists who can afford hundreds and thousands of dollars for a single wheel. The high cost of present-day composite disc wheels is primarily due to the advanced materials and manufacturing techniques required for their construction. The graphite facing sheets of solid core disc wheels are tightly bonded to the honeycomb core using high-strength adhesives. The facing sheets of tension disc wheels, consisting of woven

fabric sheets interlaced with graphite fibers and impregnated with resin, are bonded together using expensive vacuum-bagging apparatus. A single tension wheel can require as much as 40 hours of labor and cost $1,000 US or more.

Summary of the Invention

The wheel covers of the present invention add very little extra weight to the wheel and reduce the aerodynamic drag of a wheel without the stability and steering problems and prohibitive construction costs associated with solid disc wheels. As will be understood, each cover covers one side of the wheel, so that two opposed covers are required for each wheel.

In general, the wheel cover of the present invention comprises a continuous ring, a light weight porous facing, and attachment means for retaining the cover on the wheel. The cover ring has an outside diameter of a size to lie proximately within a rim of the wheel, and is preferably formed from a protruded graphite/fiber composite material. The porous cover facing is stretched across and spans the area within the ring except for an axle opening in the center of the facing, and comprises a light weight stretchable material, preferably nylon, nylon-elastodiene blend, or like knit fabric.

In a first embodiment of the wheel cover, the cover ring has a substantially U-shaped cross-section, opening inwardly toward the spokes of the wheel. The peripheral edge of the fabric facing is adhesively attached to a peripheral wall of the ring and stretched over the outer side wall of the ring and across the area within the ring. The ring is removably mounted on the wheel by attachment to the spokes of the wheel by means of a plurality of inwardly projecting, radially split pins,

each fixedly attached to the ring and frictionally attaching to a spoke of the wheel.

In a second, prefered embodiment of the wheel cover, the ring includes a peripheral bead upon which the fabric facing is retained at least in part by a flexible retainer strip having a concave channel fitting over the bead. The cover is retained on the wheel by connecting the ring to the ring of an opposed wheel cover by means of a plurality of connecting members having enlarged ends and what may be termed a dog bone or dumb bell shape, each of which ends frictionally and snugly fits within a respective axially facing channel in the cover ring it engages. The connecting members do not fasten to the wheel spokes but pass between them. One end of each connecting member is preferably slightly larger than the other to ensure that the connecting member is retained in the ring retaining their larger ends when the covers are disconnnected from each other and removed from the wheel.

The wheel covers of the present invention are easy to fabricate in that their rim components are all of uniform cross-section throughout and may be manufactured by extrusion or protrusion techniques. Their ease of fabrication includes, when the cover material is a stretched nylon knit or the like, the provision of the central axle hole simply by the burning thereof into the fabric in that the knit does not ravel or fray during use. The covers are configured to be easily adaptable to various size wheels both as to wheel diameter and as to rim width, and are attachable to the wheels without any inteference with the wheel spokes.

It is further an advantage and feature of the wheel covers of the present invention that they are very light, are porous and thus have substantially less "sail" effect in side winds than do solid disc wheels,

and in view of the knitted fabric nature of the stretchable material spanning the cover ring, provide a stroboscopic effect when rotating which is an advantageous safety feature.

Wheel covers of the present invention are especially adapted for use on racing bicycles, being of very light weight with low aerodynamic drag, and are also sufficiently inexpensive so as to be usable on a more general basis by cyclists in general because of the pleasing esthetic appearance thereof.

Other features and advantages of the present invention will become apparent from the following detailed description of two embodiments thereof, taken in conjunction with the accompanying drawings.

Brief Description of the Drawings

FIG. 1 is an exploded isometric view of a spoked bicycle wheel and two opposed wheel covers according to a first embodiment of the present invention, showing the inner face of one of the covers in full form, and the outer face of the other cover in fragmentary view.

FIG. 2 is a further isometric view showing the full outer face of one of the wheel covers shown in FIG. 1, with the wheel cover installed in place on the bicycle wheel.

FIG. 3 is a detail partial cross-sectional view on an enlarged scale of the wheel and covers of FIG. 1, showing particularly the U-shaped rings and the split pins connecting the covers to the wheel spokes.

FIG. 4 is a detail partial cross-sectional view taken substantially along line 4-4 of FIG. 5, of a spoked bicycle wheel and two opposed wheel covers according to a second, preferred embodiment of the present invention, showing the peripheral bead and lip by which the fabric facing is retained, the axially facing chan-

nels in the rings, and the plural connectors frictionally engaged therein.

FIG. 5 is a further detail partial cross-sectional view of the spoked bicycle wheel and wheel covers shown in FIG. 4, taken substantially along line 5-5 thereof.

FIG. 6 is a detail view of representative cover connectors of the type used in the wheel and cover assembly illustrated in FIG.s 4 and 5.

Description of the Preferred Embodiments

The wheel covers of the present invention provide conventional spoked wheels with the aerodynamic advantages of disc wheels without the dangerous stability and steering problems associated therewith, and without adding any substantial amount of weight to the wheel, and at a fraction of the cost of present day solid core or tension disc wheels.

As seen in FIGS. 1 and 2, a spoked wheel 2 is covered by two opposed wheel covers 10, 10a fitted proximately within a rim 4 of the wheel. Each cover 10 covers those spokes 6 and that portion of a hub 8 on one side of the wheel 2. The cover 10 comprises a ring 12 (FIG. 3) having an outside diameter sized to proximately fit within the rim 4, a porous fabric facing 14 extending across the area within the ring, and attachment means for retaining the cover upon the wheel 2. As shown in FIG. 3, to minimize the aerodynamic drag of the wheel 2 and cover 10, the cover should be substantially coplanar with the side wall 5 of the rim 4, and should provide the smoothest possible transition between the rim and the cover. However it is important that the cover 10 not extend over the wheel rim side wall 5 so that it will not interfere with the brake pads of conventional caliper brakes. The ring 12 is formed from a light weight, protruded graphite/ fiber composite in

this example, in order to have adequate strength and be consistent with minimal overall weight and minimal rotational moment of inertia of the cover 10.

To reduce the effect of side winds on the covered wheel 2, the cover facing 14 has substantial porosity to permit ready passage of air through the facing. The facing 14 is suitably fabricated of a stretched knit material having a substantially open, porous texture. Knit nylon, alone or in a blend with elastodiene, has been found to have good stretchability to provide sufficient porosity without sacrificing strength in the facing 14. To provide substantial porosity and a smooth unwrinkled surface without flapping in use, the facing 14 is radially stretched across the ring 12 to the extent of at least about 40% of its unstretched dimension and adhesively attached to the ring, as by use of contact cement.

According to a first embodiment of the present invention, shown in partial cross-sectional view in FIG. 3, the wheel 2 is covered by two opposed wheel covers 10, 10a. The ring 12 has a U-shaped cross-section oriented with an open side facing inwardly toward the wheel 2. A peripheral wall 16 of the ring 12 is positioned in close proximity to the inner surface of the rim 4. A side wall 18 depends substantially perpendicularly from an outer circumferential edge of the peripheral wall 16, and is substantially coplanar with the rim side wall 5. An inner wall 20 depends substantially perpendicularly inwardly from an inner circumferential edge of the side wall 18. The peripheral wall 16 and inner wall 20 both extend inwardly from the side wall 18 for a distance equal to approximately one-half the width of the side wall as measured between the peripheral and inner walls. For ease in manufacturing the ring 12 from a protruded graphite/fiber composite material, the

corner joints between the side wall 18 and the peripheral wall 16 and inner wall 20 are slightly rounded.

As indicated, the peripheral edge of the facing 14 is stretched over the side wall 18, and is adhesively attached to the peripheral wall 16 of the ring 12. The facing 14 extends continuously across the area within the ring, except for a small axle opening 22 at the center of the facing to accommodate the axle of the wheel 2. If a central portion of the fabric facing 14 consists of a nylon or nylon-elastodiene blend, the axle opening 22 can be cut into the facing by means of a heated cutting device, simultaneously forming the axle opening and fusing the fabric to prevent fraying.

The cover 10 is retained upon the wheel 2 by removably connecting the ring 12 to the spokes 6. A plurality of connector pins 24 project inwardly from the side wall 18 of the ring 12. Each pin 24 is a relatively small diameter, cylindrical element having a proximal end adhesively bonded to the inner surface of the side wall 18, and extending inwardly therefrom to a distal end. As will be understood, the distal end of each pin 24 is radially split to receive one of the spokes 6 and to be frictionally retained thereon, thereby removably connecting the ring 12 to the spoke. Several, suitably four, radially split pins 24 spaced equally around the circumference of the ring 12 securely retain the cover 10 upon the wheel 2. As will be understood, and as shown at FIG. 3 for example, the opposed cover 10a used with the cover 10 to complete the wheel cover assembly on wheel 2 is similarly of identical construction to that of wheel cover 10, and the elements thereof, as shown in FIG. 3, have been indicated with like numerals, each with a subscript "a".

In a preferred, second embodiment of the present invention, cover 28, as shown in the partial cross-

sectional views of FIGS. 4 and 5, comprises a cover ring 30 which is a solid member having a generally rectangular cross-section. The base of the rectangle forms an inside surface 32 of the ring 30 closest to the center of the wheel 2. The sides of the rectangle form an inner side surface 34 and an outer side surface 36. The inner and outer side surfaces 34, 36 extend from the inside surface 32 peripherally toward a peripheral bead 38. The bead 38 extends along the perimeter of the ring 30 in contact with or in close proximity to the inner surface of the wheel rim 4. The edge of the facing 40 is wrapped around the bead 38 and securely retained thereon by a flexible retainer strip 42 having a concave channel 44 of a size to fit tightly over the bead. The channel 44 subtends an angle of more than 180° around the circular cross-section of the bead 38 to securely retain the strip 42 and facing 40 upon the bead.

Lip portion 46 of the strip 42 extends peripherally substantially to the inner surface of the rim 4 and aids to position the cover 28 substantially against the rim 4, reducing the aerodynamic drag of the covered wheel 2. The distal edge of the lip 46 contacts the inner surface of the rim 4 and is angled inwardly to keep the lip 46 from slipping onto the rim side wall 5 and interfering with the operation of the brake pads.

The wheel cover 28 and its opposite counterpart cover 28a are retained on the wheel 2 by direct interconnection. As shown in FIG. 4 the opposed covers 28, 28a are suitably removably connected by a plurality of connectors 48 of generally dog bone or dumb bell shaped cross-section, having enlarged ends 50, 52. The enlarged connector ends 50, 52 are frictionally retained within continuous axially facing concave channels or slots 54, 54a in the respective inner side surfaces 34, 34a of the rings 30, 30a of the opposed covers 28,

28a. One end 50 of each connector 48 is preferably slightly larger than the other end 52 to ensure that the connector will be retained in the ring 30a containing the larger connector end 50 when the covers 28, 28a are disconnected from each other and removed from the wheel 2.

As will be understood, the wheel cover 28a, oppositely mounted of the wheel cover 28 is suitably identical to wheel cover 30, and the elements thereof shown in FIG. 4 are indicated with like numerals, each with a subcript "a".

Cover interconnections of various lengths are contemplated, and two such connectors are shown in FIG. 6, simply by way of example, and there designated 48 and 48A. With a selection of enlarged end connectors such as 48, 48A of various lengths available, the wheel covers 28, 28a may be mounted on wheels of various widths between the rim side walls 5, the connector length selected in a given instance being such that the covers when mounted are substantially flush or coplanar with the wheel rim side walls. Also, facing retainer strips 42, 42a and the lips 46, 46a thereof, being formed of relatively soft plastic or the like so as to be self adapting to wheel rims of various diameters within a limited range.

It is considered desirable to retain the stretched fabric or like facing 40 on its associated ring 30 simply by the clamping effect of the associated retainer strip 42 on bead 38, to facilitate assembly of the cover and facilitate the tightening of the facing 40 or replacement thereof by the user. However, as will be apparent, the facing 40 may be adhesively bonded between the bead 38 and the strip 42 and even to the outer face of the ring 30 if desired, and a known non-destructive or "peelable" adhesive between these parts, used in

conjunction with the retainer strip 42, is also considered feasible.

It is an important feature of the second, preferred embodiment of the invention, such as illustrated in FIGS. 4-6, that all parts thereof except for the stretchable fabric or like facing 40 are of uniform cross-section throughout, and thus may be formed by protrusion or extrusion techniques. Thus, rings 30, 30a are of identical cross-section including their respective beads 38, 38a and channels 54, 54a throughout, and the retainer strips 42, 42a are likewise of identical cross-section throughout. Likewise, the connectors 48, 48A are each of identical cross-section throughout in any given instance, i.e. any given connector 48 or 48A is fabricated simply by cutting a segment from a strip of the cross-section shown and of indeterminate length. Thus, two such segments are shown in cross-section in FIG. 5, spaced intermediately between the spokes 6 of the wheel 2. It is also an advantage of the arrangement shown in FIGS. 4 and 5 that, since the grooves 54, 54a in the rings 30, 30a are continuous (as in FIG. 5), the connectors 48, 48A interconnecting the covers 28, 28a may be placed anywhere desired along such grooves, and are not restricted in location to a particular association with any particular spoke 6 and may be spaced freely therebetween.

As a specific example, utilizing the form of wheel cover assembly shown in FIGS. 4 and 5, and utilizing a light weight nylon knit as the facing material, a wheel cover on a wheel with a 27 inch (68.6 cm) x 1-1/4 inch (3.2 cm) tire suitably has an outside diameter of about 23.9 (60.7 cm) inches, weighs about 80 grams, and the nylon knit facing thereon is stretched radially about 40% of its nominal, unstretched dimension, which approximately doubles the area thereof. The extent of poro-

sity of the knit fabric making up the facing is generally proportional to the extent of the stretching thereof, and it has been found that wheel covers of the present invention should have a porosity factor (considered as a ratio of the effective total area of the openings of the stretched fabric to the total facing area) of at least about 50%. It is also an important characteristic of the fabric when thus stretched to form the wheel cover facing that the porosity thereof is substantially uniformly distributed throughout the face area.

While the primary application of wheel covers of the prsent invention is considered to be for wheel covers on racing bicycles, other applications where spoked wheels are involved and where minimal weight and aerodynamic drag are advantageous, such as on the wheels of racing sulkies and racing wheelchairs are contemplated. Further, in view of the relative simplicity and inexpensive construction of wheel covers of the present invention, it will be evident that such may be used advantageously on spoked wheels in general and in other than racing environments, in view of the pleasing, "clean" esthetic appearance of the covers and for reasons of safety, it being notable in the latter regard that the use of knit fabric as the facing material of the wheel covers renders them particularly adaptable to the use of striking colors of a fluorescent nature or otherwise.

It will be appreciated that, although specific embodiments of the invention have been described herein for purposes of illustration, various modifications may be made without departing from the spirit and scope of the invention. Accordingly, the scope of the invention is not limited except as by the following claims.

Claims

WHAT IS CLAIMED IS:

1. A wheel cover for a spoked wheel, comprising:

(a) a continuous ring having an outside diameter of a size to lie proximately within the rim of the wheel;

(b) a cover facing comprising a light weight, porous material, stretched across and attached to said ring and extending continuously across the ring except for an axle opening in the center of the facing; and

(c) attachment means for retaining the ring on the wheel.

2. A wheel cover according to claim 1, wherein the cover facing has a porosity factor of at least about 50% and the facing has a substantially uniform porosity throughout.

3. A wheel cover according to claim 1, wherein the material spanning the ring is knit fabric, stretched radially at least about 40% of its nominal unstretched dimension.

4. A wheel cover according to claim 3, wherein the knit fabric facing spans the ring and is continuous therebetween except for a central axle opening formed in the facing by burning thereof to minimize fraying of the opening.

5. A wheel cover according to claim 3, wherein the ring is formed from a protruded graphite/fiber composite or the like and the facing comprises a porous nylon, nylon-elastodiene blend, or like knit fabric.

6. A wheel cover according to claim 3, wherein the ring is protruded graphite/fiber, the facing is nylon blend knit fabric, and the total weight thereof is about 80 grams.

7. A wheel cover according to claim 1, wherein the ring has a substantially U-shaped cross-section opening inwardly toward the spokes of the wheel, and wherein the facing is bonded to a peripheral wall of the ring and stretched across a side wall of the ring.

8. A wheel cover according to claim 7, wherein said attaching means frictionally engages spokes of the wheel.

9. A wheel cover according to claim 1, further including a peripheral bead on the ring and on which the facing is retained by a flexible retainer strip having a concave channel frictionally engaging said bead.

10. A wheel cover according to claim 9, wherein the retainer strip peripherally includes a flexible lip contacting the inner surface of the wheel rim.

11. In combination, two wheel covers according to claim 9, arranged in opposed relation and spanning the spokes of a wheel, with the rings of the wheel covers being removably attached to each other and with the edges of the cover facings being substantially coplanar with the sides of the wheel rim.

12. Wheel covers according to claim 11, wherein the attachment means comprises:

(a) an axially facing concave slot in each ring, and

(b) connector means interconnecting and frictionally retained within the concave slots of the rings of the opposed covers.

13. A wheel cover according to claim 12, wherein the connector means comprises a plurality of connecting members having enlarged ends fitting within the respective concave slots of the opposed covers.

14. Wheel covers according to claim 13, wherein one end of each connecting member is larger than its other end.

15. In combination with a spoked wheel, an opposed pair of wheel covers substantially spanning respective sides of the wheel spokes, each of the wheel covers comprising a circumferential ring having a continuous, axially directed concave channel, and connector means between the cover rings having enlarged ends which are frictionally retained in the respective ring channels.

16. The combination of claim 15, wherein the connector means are cross-sectionally of generally dumb bell shape.

17. The combination of claim 16, wherein the ring of each wheel cover comprises a continuous peripheral bead, the cover facing being retained on the ring by means of a continuous peripherally arranged retainer strip having a concave channel frictionally engaging said bead and

retaining the edge of the facing therebetween.

18. The combination of claim 17, wherein each of the wheel rings, the retainer strips, and the connector means are respectively of like cross-section throughout so as to be formable by protrusion, extrusion or the like.

19. The combination of claim 15, wherein the channel in each cover ring extends continuously around the ring, enabling the connector means to be placed between the wheel spokes at any selected position along the ring channels.

20. Wheel covers and components thereof, substantially as shown and described

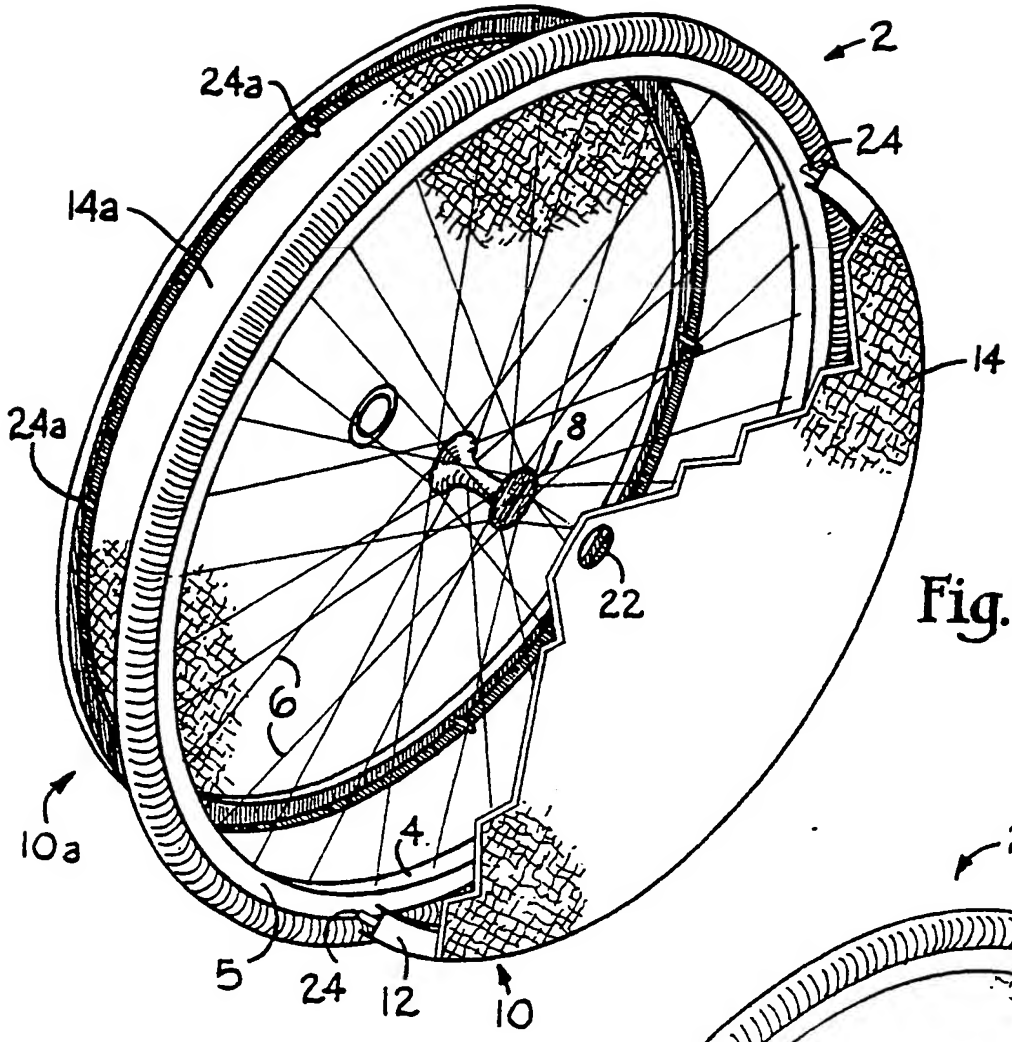


Fig.1

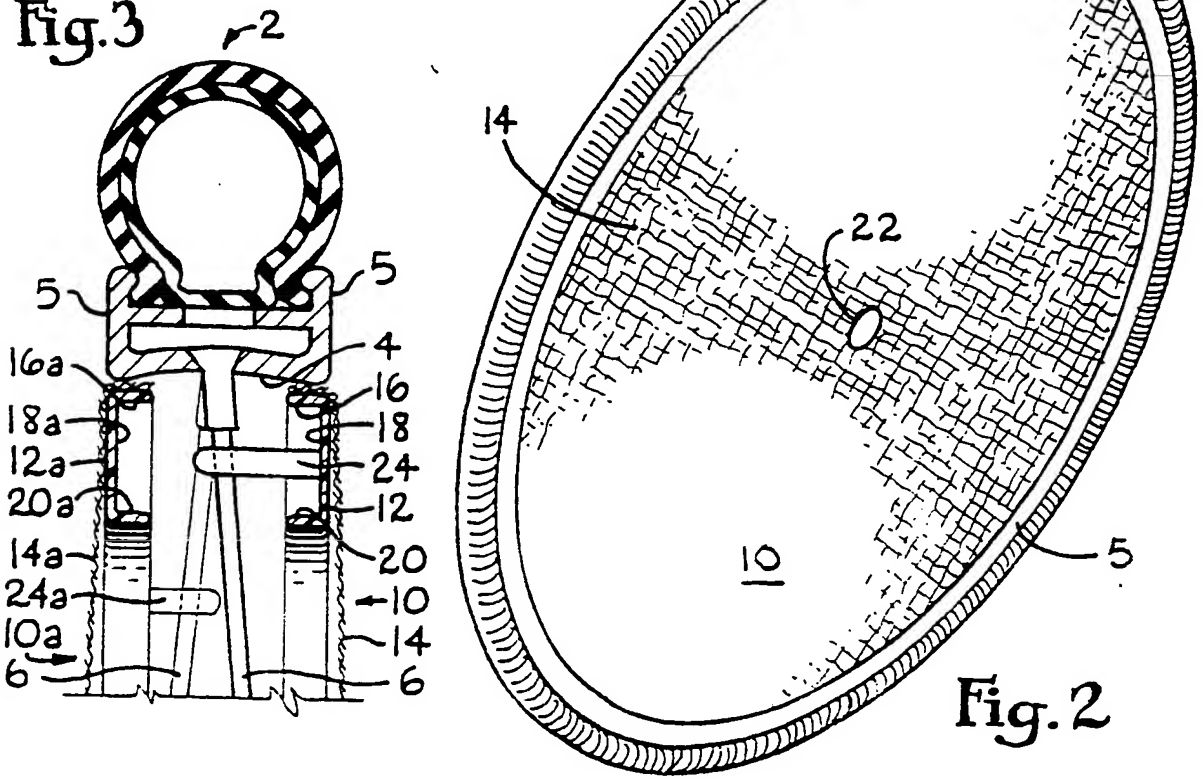


Fig.2

Fig.3

Fig. 4

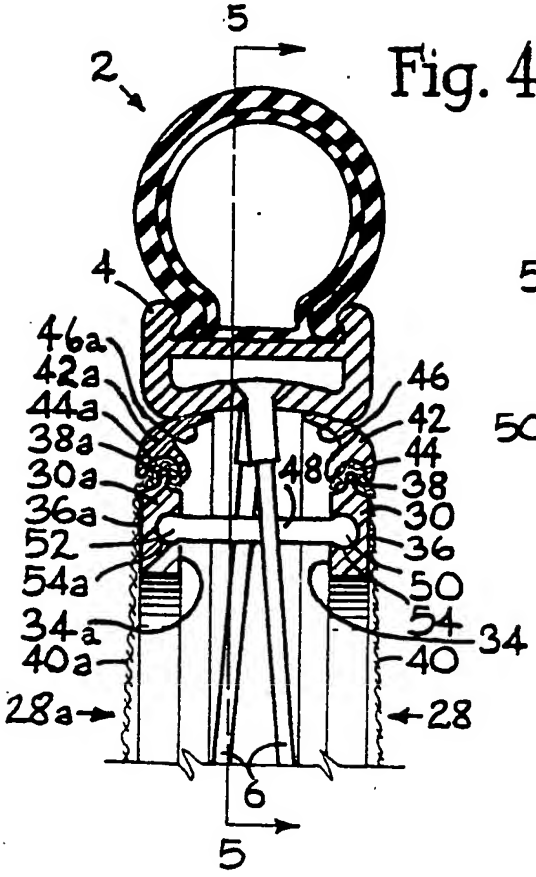


Fig. 6

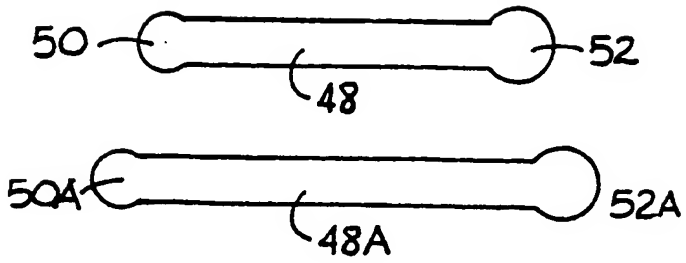
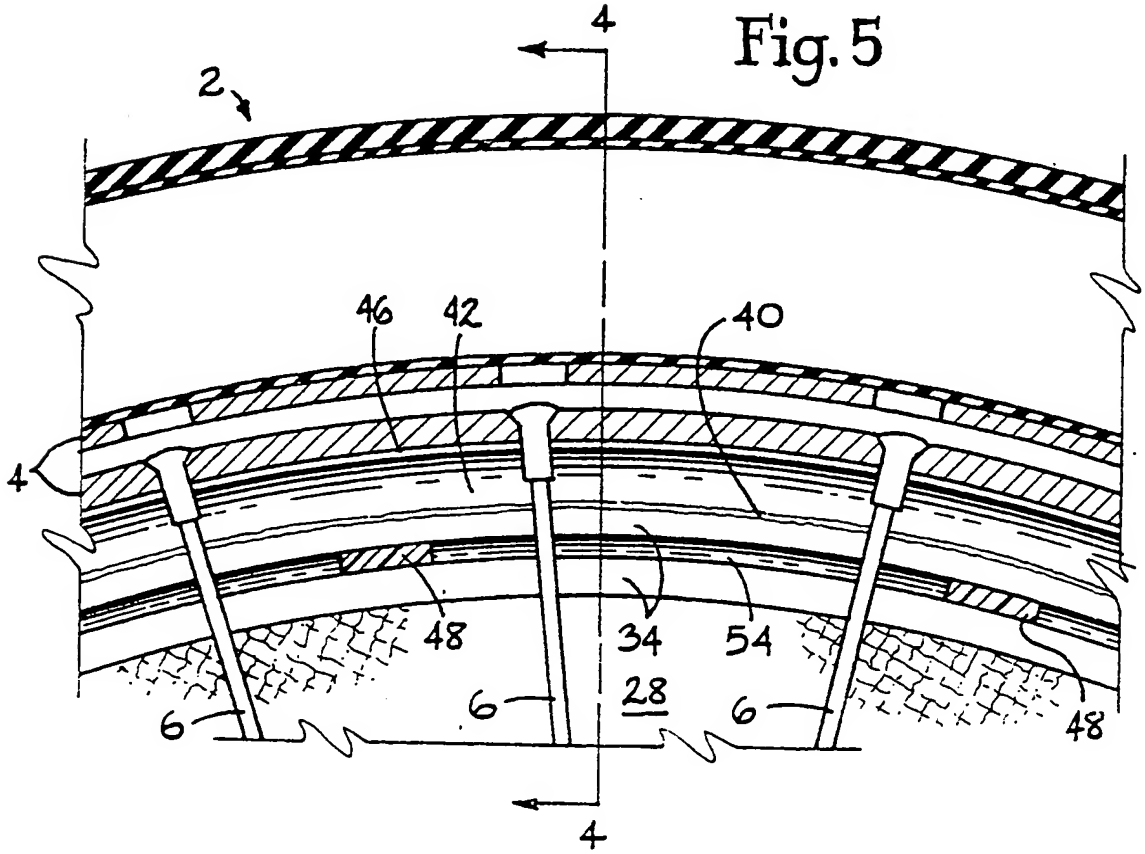


Fig. 5



TERNATIONAL SEARCH REPOR.

International Application No PCT/US 86/ 00248

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) 3

According to International Patent Classification (IPC) or to both National Classification and IPC

INT. CL. 4 B60 B 7/02, 7/06
U.S. CL. 301/37R, 37 SA

II. FIELDS SEARCHED

Minimum Documentation Searched 4

Classification System	Classification Symbols
U.S.	301/37R, 37S, 37SA, 37CM, 37P, 37H, 55

Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched 5

III. DOCUMENTS CONSIDERED TO BE RELEVANT 14

Category *	Citation of Document, 16 with indication, where appropriate, of the relevant passages 17	Relevant to Claim No. 18
Y	GB, A, 126,718, (DUNLOP ET AL) 22 May 1919	1-8
Y	US, A, 1,167,124, (SLOPER) 04 January 1916	1-8
Y	US, A, 1,223,743, (SLOPER) 24 April 1917	1-8
Y	US, A, 4,500,102, (HAURY ET AL) 19 February 1985	8
A	US, A, 3,004,798, (TYLLE) 17 October 1961	
A	US, A, 4,202,582, (SELTMAN) 13 May 1980	
A	US, A, 4,418,962, (SCHAFFER) 06 December 1983	

* Special categories of cited documents: 15

"A" document defining the general state of the art which is not considered to be of particular relevance

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"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

IV. CERTIFICATION

Date of the Actual Completion of the International Search 2	Date of Mailing of this International Search Report 2
07 April 1986	21 APR 1986
International Searching Authority 1	Signature of Authorized Officer 20
ISA/US	D. A. Scherbel

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